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Committee on the Peaceful Uses of Outer Space

National research on space debris, safety of space objects with nuclear power sources on board and problems of their collisions with space debris

Note by the Secretariat*

Addendum

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* The present document contains replies received from Member States and international organizations between 26 January and 22 February 2001.

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I. Introduction

1. At its forty-third session, the Committee on the Peaceful Uses of Outer Space agreed that Member States should continue to be invited to report to the Secretary-General on a regular basis with regard to national and international research concerning the safety of space objects with nuclear power sources, that further studies should be conducted on the issue of collision of orbiting space objects with nuclear power sources on board with space debris and that the Committee's Scientific and Technical Subcommittee should be kept informed of the results of such studies [1]. The Committee also took note of the agreement of the Subcommittee that national research on space debris should continue and that Member States and international organizations should make available to all interested parties the results of that research, including information on practices adopted that had proved effective in minimizing the creation of space debris (A/AC.105/736, para. 96).

2. Information received by Member States and international organizations as at 24 November 2000 is contained in the note by the Secretariat of 27 November 2000 (A/AC.105/751). Information received between 25 November 2000 and 25 January 2001 is contained in an addendum to that document (A/AC.105/751/Add.1). The present document contains information submitted by Member States and international organizations between 26 January and 22 February 2001.

II. Replies received from Member States and international organizations

Germany

A. General

1. In the year 2000, activities in Germany related to space debris were mainly performed under contract with the European Space Agency (ESA) and essentially covered:

(a) The improvement of methods for debris tracking with the radar facility of the Research Establishment for Applied Science (FGAN) in Wachtberg-Werthoven;

(b) The involvement of FGAN in various object observation campaigns;

(c) The upgrading of the 1-metre Zeiss Telescope on Tenerife, in the Canary Islands of Spain;

(d) The upgrading of the ESA Meteoroid and Space Debris Terrestrial Environment Reference Model (MASTER) by the Institute for Flight Mechanics and Spaceflight Technology of the Technical University of Braunschweig (IFR TU BS) as well as by the company eta_max;

(e) A contribution by eta_max to the upgrading of the ESA Database and Information System for the Characterisation of Objects in Space (DISCOS);

[1] *Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 20* (A/55/20), para. 99.

(f) Investigations in meteoroid and space debris protection systems by the Ernst-Mach-Institut in Freiburg;

(g) The updating of the meteoroid model to predict impacts on spacecraft by the Max Planck-Institute in Heidelberg;

(h) The improvement of the re-entry fragmentation model Space Craft Atmospheric Reentry Aerothermal Breakup (SCARAB) by Hypersonic Technology Göttingen.

2. Only an overview on the main activities is given here. For more details, the German Space Agency, represented by the German Aerospace Center (DLR) Space Management (Koenigswinterer Str. 522-524, D-53227 Bonn, Germany), can be contacted.

B. Radar observation and data analysis of space debris and meteoroids

3. Studies related to space debris at the Research Institute for High-Frequency Physics and Radar Techniques (FGAN-FHR) Division of Radar Techniques for Space Reconnaissance (RWA), are aimed primarily at the investigation and development of radar techniques and analysis methods to detect and classify man-made space objects and meteoroids. Radar data of larger space debris are gained in the tracking mode of operation using the Tracking and Imaging Radar (TIRA) system. From those data, the physical properties, such as size, shape, dimensions, intrinsic motion, mass, orbit and orbital lifetime, are derived. The space debris population density is derived from radar observations of defined space volumes in the beam-park mode of operation. For the observation of meteoroids (e.g. Perseids and Leonids), the radar antenna points in the direction of the meteoroid stream radiant (beam-park mode of operation with compensation for the Earth's rotation).

4. In 2000, activities related to space debris were funded by ESA European Space Operations Centre (ESOC). The following were addressed:

(a) *Beam-park experiment BPE-1 2000*. The Inter-Agency Space Debris Coordination Committee recommended the preparation of an international 24-hour beam-park experiment during its 17th meeting, held in Darmstadt in October 1999. The participation of FGAN was coordinated with the National Aeronautics and Space Administration (NASA) of the United States of America and the experiment was successfully conducted on 27 and 28 October 2000. The range window of the L-band radar of TIRA covered the entire low-Earth orbital region (altitude of 300-2,000 km). An expected peak in the population density at an altitude of 1,400 km was confirmed by the measured data;

(b) *Radar techniques for fragmentation and damage analysis of larger space debris*. The European remote sensing satellite (ERS-1) was observed shortly after it went out of operation. From highly range-resolved radar data, radar images and films were computed to analyse the spacecraft attitude and the orientation of its solar panels;

(c) *Participation in the third re-entry exercise of the Inter-Agency Space Debris Coordination Committee*. A Soyuz upper stage (object 25947, launched from Baikonur on 18 October 1999), used by Starsem to launch Globalstar constellation satellites, was selected as the re-entry object. The object was observed worldwide and orbital lifetime and re-entry windows (time and location) were estimated and

stored for comparison in the ESA ESOC re-entry database. The exercise started about 10 days prior to the assessed re-entry date (on 4 March 2000 at 0550 (UTC)). FGAN delivered 11 sets of two-line elements computed from TIRA measurements;

(d) *Radar observation and data analysis of meteoroid streams*. FGAN completed the analysis of head-on radar reflections of the Leonids, which were collected on 16-18 November 1999. The velocity histogram shows two distinct peaks, at about 57.5 km/s (which could be background flux) and at 70.5 km/s. Extended analysis revealed that both stream components come from the same direction. Some further measurements and analysis are under discussion.

C. Planning of activities on space debris in the period from 2001 to 2003

5. A work plan has been prepared for the period from 2001 to 2003 on the basis of presentations and discussions during a workshop held in February 2000 at DLR. The work plan describes a proposal for a project aimed at retaining the competence and expertise related to space debris of institutions and facilities in Germany and to contribute to international programmes or projects (in particular in the framework of the ESA network of technical centres on space debris and in the Inter-Agency Space Debris Coordination Committee). The project, which is named "Space Debris End-to-End Service", will form a service for customers and operators, as well as for industry, from the initial phase to the operational phase of space projects. That would give users of outer space the possibility to obtain information on national and international agreements, guidelines and standards on space debris mitigation, as well as to support the achievement of design and operational requirements of spacecraft in this respect.

6. The project is subdivided into work packages that cover the following activities:

(a) Conception of an end-to-end service (contributions by research institutes, universities, industry (research and development, product assurance) and operators);

(b) Identification of national needs, state of knowledge and information (contributions by governmental authorities, research institutes, industry (research and development, product assurance), operators and insurance companies);

(c) Mitigation measures (consequences on design, by research institutes, universities, industry and operators);

(d) Re-entry analysis (development of destruction and fragmentation models and radar analysis by research institutes);

(e) Application of a pilot project, including system review, meteoroid and debris modelling, hazard analysis and recommendations of measures (involvement of industry, research institutes, universities and operators);

(f) Cost-benefit analysis (with industry, operators and others).

The project will run 30 months, starting in the spring of 2001.

7. In addition, the project will support the initiative of the thirty-seventh session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space involving a work plan over the next few years to investigate the economic and effectivity aspects of space debris mitigation measures.

D. Contributions to the Inter-Agency Space Debris Coordination Committee

8. Under DLR contract, the company eta max has established a web site (www.iadc-online.org) for informing the public about the Inter-Agency Space Debris Coordination Committee, as well as for the exchange of information among the member agencies and associated organizations of the Coordination Committee.

9. DLR has taken over the chairmanship of the Inter-Agency Space Debris Coordination Committee and is organizing the 19th meeting of the Coordination Committee, which is to be held in Cologne from 22 to 23 March 2001.